

WIRING BOARD, ITS PRODUCTION AND LIQUID CRYSTAL ELEMENT HAVING THIS WIRING BOARD

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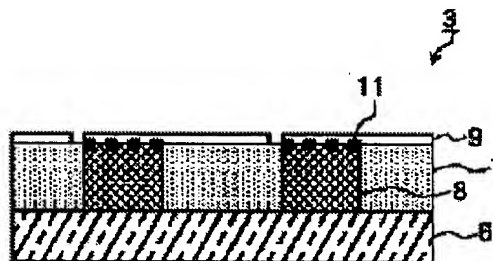
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Abstract of JP9230318

PROBLEM TO BE SOLVED: To obtain a wiring board with which the curing of the surface of the resin packed between metallic wirings to a smooth surface is possible by arranging spacers in at least part of the boundary surface of the metallic wirings and transparent electrodes. **SOLUTION:** An Al film is formed by a sputtering method on a glass substrate 6 to form the metallic wirings 8. Further, the spacers 11 of a silica glass system are dispersed into a solvent and the soln. prepd. in such a manner is applied on the surface of the metallic wirings 8 and is then cured. The UV curing resin 7 is dropped in a prescribed amt. between the respective metallic wirings 8 on this glass substrate 6 and thereafter, a mold plate having the smooth surface through which UV light passes is brought into contact with the UV curing resin 7. Next, a prescribed pressure is applied on the integral assembly of the glass substrate 6 and the mold plate holding the UV curing resin 7 to bring both into tight contact with each other. Next, the integral assembly of the glass substrate 6 and the UV curing resin 7 is peeled from the mold plate and transparent electrodes 9 are formed on the UV curing resin 7 in compliance with the wiring patterns of the metallic wirings 8. An alignment layer is formed thereon, by which the wiring board 3 is obtd.



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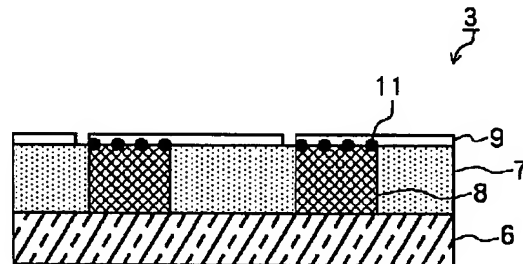
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(54) 【発明の名称】 配線基板、その製造方法及び該配線基板を備えた液晶素子

(57) 【要約】

【課題】樹脂の硬化による収縮を抑制して樹脂表面を平滑にする。

【解決手段】金属配線8上にスペーサー11を配置して、金属配線8間にUV硬化樹脂7を加圧充填してUV光の照射により硬化することにより、スペーサー11の変形、及びスペーサー11の金属配線8内へのもぐり込みによって、UV硬化樹脂7の硬化による収縮が抑制されてその表面が凹凸のない平滑面になり、透明電極9との密着性がよくなる。



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【特許請求の範囲】

【請求項 1】 基板表面に配線パターンされた金属配線と、前記金属配線の間に該金属配線とほぼ同じ厚さで充填された樹脂と、前記樹脂上に前記金属配線と電気的に接するようにして形成された透明電極と、を有する配線基板において、

前記金属配線と前記透明電極の界面の少なくとも一部にスペーサーを配置した、
ことを特徴とする配線基板。

【請求項 2】 前記スペーサーはガラス系又は樹脂系の粒子からなり、その粒径は 0.01~1 μ m である、
請求項 1 記載の配線基板。

【請求項 3】 前記透明電極は ITO 膜である、
請求項 1 記載の配線基板。

【請求項 4】 前記金属配線は低抵抗の金属又は金属合金で形成される、請求項 1 記載の配線基板。

【請求項 5】 前記樹脂は紫外線硬化樹脂である、
請求項 1 記載の配線基板。

【請求項 6】 前記基板上的前記金属配線間にカラーフィルターを配置した、
請求項 1 記載の配線基板。

【請求項 7】 前記基板と前記金属配線との間にカラーフィルターを配置した、
請求項 1 記載の配線基板。

【請求項 8】 前記カラーフィルターと前記金属配線との間に前記カラーフィルターの保護層を形成した、
請求項 7 記載の配線基板。

【請求項 9】 基板上に金属配線を形成する第 1 の工程と、前記金属配線の間に樹脂を充填し、前記樹脂を型板を介して加圧する第 2 の工程と、前記樹脂に光を照射して硬化させる第 3 の工程と、前記型板を離型して、前記樹脂上に前記金属配線と電気的に接するようにして前記透明電極を形成する第 4 の工程と、を有する配線基板の製造方法において、

前記第 2 の工程で、前記金属配線と前記型板との間にスペーサーを配置して、前記金属配線と前記型板の間に前記樹脂を加圧充填する、

ことを特徴とする配線基板の製造方法。

【請求項 10】 前記スペーサーはガラス系又は樹脂系の粒子からなり、その粒径は 0.01~1 μ m である、
請求項 9 記載の配線基板の製造方法。

【請求項 11】 前記透明電極は ITO 膜である、
請求項 9 記載の配線基板の製造方法。

【請求項 12】 前記金属配線は低抵抗の金属又は金属合金で形成される、請求項 9 記載の配線基板の製造方法。

【請求項 13】 前記光は紫外線光である、
請求項 9 記載の配線基板の製造方法。

【請求項 14】 前記樹脂は紫外線硬化樹脂である、
請求項 9 記載の配線基板の製造方法。

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【請求項 15】 前記基板上的前記金属配線間にカラーフィルターを配置した、

請求項 9 記載の配線基板の製造方法。

【請求項 16】 前記基板と前記透明電極との間にカラーフィルターを配置した、

請求項 9 記載の配線基板の製造方法。

【請求項 17】 前記カラーフィルターと前記金属配線との間に前記カラーフィルターの保護層を形成した、
請求項 16 記載の配線基板の製造方法。

【請求項 18】 互いに対向するように配置された一対の電極基板の間に液晶を挟持してなる液晶素子において、

少なくとも一方の前記電極基板は、基板と、
前記基板表面に配線パターンされた金属配線と、
前記金属配線の間に該金属配線とほぼ同じ厚さに充填された樹脂と、
前記樹脂上に前記金属配線と電気的に接するようにして形成された透明電極と、からなり、
前記金属配線と前記透明電極の界面の少なくとも一部にスペーサーを配置した、
ことを特徴とする液晶素子。

【請求項 19】 前記スペーサーはガラス系又は樹脂系の粒子からなり、その粒径は 0.01~1 μ m である、
請求項 18 記載の液晶素子。

【請求項 20】 前記基板はガラス基板である、
請求項 18 記載の液晶素子。

【請求項 21】 前記透明電極は ITO 膜である、
請求項 18 記載の液晶素子。

【請求項 22】 前記金属配線は低抵抗の金属又は金属合金で形成される、
請求項 18 記載の液晶素子。

【請求項 23】 前記樹脂は紫外線硬化樹脂である、
請求項 18 記載の液晶素子。

【請求項 24】 前記基板上的前記金属配線間にカラーフィルターを配置した、
請求項 18 記載の液晶素子。

【請求項 25】 前記基板と前記金属配線との間にカラーフィルターを配置した、
請求項 18 記載の液晶素子。

【請求項 26】 前記カラーフィルターと前記金属配線との間に前記カラーフィルターの保護層を形成した、
請求項 25 記載の液晶素子。

【請求項 27】 前記液晶は強誘電性液晶である、
請求項 18 記載の液晶素子。

【請求項 28】 前記強誘電性液晶はカイラルスメクチック液晶である、
請求項 27 記載の液晶素子。

【請求項 29】 前記透明電極上に配向膜を形成した、
請求項 18 記載の液晶素子。

50 【請求項 30】 前記各電極基板の前記透明電極及び前

記金属配線は単純マトリクス配置される、
請求項18記載の液晶素子。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、配線基板、特に金属配線に透明電極を形成した配線基板、その製造方法及び該配線基板を備えた液晶素子に関する。

【0002】

【従来の技術】TN (Twisted Nematic) やSTN (Super Twisted Nematic) 型等の液晶素子では、従来より、ガラス基板上に形成される透明電極にはITO (Indium TinOxide) 膜が一般に用いられている。

【0003】上述した透明電極を構成するITO膜は抵抗値が高いため、最近のように表示面積の大型化、高精細化に伴って印加される電圧波形の遅延が問題になってきた。特に、強誘電性液晶を用いた液晶素子ではセルギャップが1~3 μ mとより狭いため、電圧波形の遅延が顕著であった。また、抵抗値を低くするために透明電極を厚く形成することも考えられるが、膜厚を厚くすると成膜に時間、コストがかかる、透明性が悪くなる等の問題点があった。

【0004】このような問題点を解決するために、膜厚の薄い透明電極に併設して低抵抗値の金属配線を形成する構成の電極基板が提案されている(例えば、特開平2-63019号公報)。この公報に開示されている電極基板は、金属配線を透明な絶縁物で埋め込み、表面に金属パターンを露出した金属配線に、ITO膜等の透明電極を形成したものである。

【0005】上述したような構成の電極基板を作製する場合、金属配線間を埋めて平坦化する絶縁物として透明な樹脂を用いる構成の電極基板が提案されている(例えば、特開平6-347810号公報)。

【0006】このような低抵抗率の金属配線を、透明電極を形成する下地のガラス基板に形成して電極基板(配線基板)を作製する場合、従来、例えば図9乃至図11に示すような製造方法によって行われていた。

【0007】先ず、ガラス基板101上に、1 μ m程度の膜厚からなる金属配線102を形成する(図9(a)参照)。金属配線102は、例えばスパッタ法等によってガラス基板101上に金属膜層を形成した後、フォトリソ法によりパターンニングして形成することができる。

【0008】次に、シランカップリング処理を施したガラス基板101上に、UV(紫外線)硬化樹脂103を定量液状治具(図示省略)で所定量滴下し(図9(b)参照)、平滑な型板104でUV硬化樹脂103を挟むように接触させる(図9(c)参照)。

【0009】次に、ガラス基板101と型板104とでUV硬化樹脂103を挟んだ一体物をプレス機(図示省略)内に入れ、加圧してガラス基板101と型板104

を密着させる(図10(a)参照)。この時、後の工程でITO膜等の透明電極と金属配線102が接触して導通性を保つようにするため、UV硬化樹脂103を金属配線102の表面上から除去するか、又は極薄く樹脂が残る程度になるように、ガラス基板101と型板104とを強く、しかも基板全面に均一に密着させる。

【0010】次に、このUV硬化樹脂103を硬化させるために、ガラス基板101と型板104の一体物をプレス機(図示省略)内から取り出し、型板104側からUV(紫外線)光105を照射してUV硬化樹脂103を硬化させる(図10(b)参照)。

【0011】次に、離型治具(図示省略)により型板104からガラス基板101とUV硬化樹脂103の一体物を剥離し(図10(c)、(d)参照)、UV硬化樹脂103上に金属配線102と電気的に接するようにしてITO膜からなる透明電極106を成膜、パターンニングして、金属配線102をUV硬化樹脂103埋め込んだ電極基板(配線基板)100を得ていた(図11参照)。

【0012】

【発明が解決しようとする課題】ところで、上述した従来の製造方法によって作製される電極基板(配線基板)100では、図10(b)に示したようにUV硬化樹脂103にUV光105が照射されると、UV硬化樹脂103の硬化による収縮力Fによりその表面に収縮が生じて、UV硬化樹脂103の表面が平滑面でなく凹凸面103aになるという問題点があった。以下、UV硬化樹脂103の表面が凹凸面103aになることについて説明する。

【0013】UV硬化樹脂103は一般に数%の硬化収縮率 α を有しており、例えばアクリル系樹脂で6~10%、エポキシ系樹脂で2~5%である。そして、ガラス基板101上に形成される金属配線102の厚みをhとすると、金属配線102間に充填されるUV硬化樹脂103には単位体積当たり、 α (硬化収縮率) \times h(厚み)に相当する収縮力、即ち、 α (硬化収縮率) \times h(厚み)の厚み分だけ縮もうとする力が、型板104とUV硬化樹脂103の界面に働く。

【0014】この際、金属配線102が、型板104とUV硬化樹脂103間の支柱として機能するため、上述した収縮力はUV硬化樹脂103の密着性を向上させるために、シランカップリング処理が施されているガラス基板101ではなく、シランカップリング処理が施されていない型板104からUV硬化樹脂103を引き剥がそうとする力として働き、その結果、UV硬化樹脂103が型板104から離型する。

【0015】そして、この離型が急激に起こるために、離型する際にUV硬化樹脂103の表面に収縮による凹凸面103aが形成されることとなる。

【0016】このように、UV硬化樹脂103の表面が

凹凸面103aとなることにより、その表面に成膜されるITO膜からなる透明電極106も同様に表面が平滑面ではなく凹凸面となる。このため、UV硬化樹脂103と透明電極106との接触面の平坦性が悪くなり、UV硬化樹脂103と透明電極106との密着性が悪くなる。

【0017】更に、一对のこの配線基板（配線基板）100間に液晶を注入して得られる液晶素子では、透明電極106上に形成される配向膜（図示省略）の表面も同様に凹凸面となる。このため、配向処理が均一でなく乱れた状態となり、光学状態のムラやクロストークが発生して表示品位の低下を招くという問題点があった。

【0018】そこで、本発明は、金属配線間に充填する樹脂表面を平滑な面にして硬化することができる配線基板、その製造方法及び該配線基板を備えた液晶素子を提供することを目的とする。

【0019】

【課題を解決するための手段】上記のような問題を解決するために、基板表面に配線パターンされた金属配線と、前記金属配線の上に該金属配線とはほぼ同じ厚さで充填された樹脂と、前記樹脂上に前記金属配線と電気的に接するようにして形成された透明電極と、を有する配線基板において、前記金属配線と前記透明電極の界面の少なくとも一部にスペーサーを配置したことを特徴としている。

【0020】また、基板上に金属配線を形成する第1の工程と、前記金属配線の上に樹脂を充填し、前記樹脂を型板を介して加圧する第2の工程と、前記樹脂に光を照射して硬化させる第3の工程と、前記型板を離型して、前記樹脂上に前記金属配線と電気的に接するようにして前記透明電極を形成する第4の工程と、を有する配線基板の製造方法において、前記第2の工程で、前記金属配線と前記型板との間にスペーサーを配置して、前記金属配線と前記型板の間に前記樹脂を加圧充填することを特徴としている。

【0021】また、互いに対向するように配置された一对の電極基板の間に液晶を挟持してなる液晶素子において、少なくとも一方の前記電極基板は、基板と、前記基板表面に配線パターンされた金属配線と、前記金属配線の上に該金属配線とはほぼ同じ厚さで充填された樹脂と、前記樹脂上に前記金属配線と電気的に接するようにして形成された透明電極と、からなり、前記金属配線と透明電極の界面の少なくとも一部にスペーサーを配置したことを特徴としている。

【0022】また、前記スペーサーはガラス系又は樹脂系の粒子からなり、その粒径は0.01~1μmであることを特徴としている。

【0023】

【発明の実施の形態】以下、図面に基づいて本発明の実施の形態を説明する。

【0024】図1は、本発明の第1の実施の形態に係る配線基板を備えた液晶素子を示す概略断面図である。この液晶素子1は、偏光板2a、2b間に対向して配置された一对の配線基板である電極基板3a、3bを備えており、電極基板3a、3bは、径が均一な粒状のスペーサ4により所定のセルギャップ（例えば、1.5μm）で貼り付けられており、その間に電界に対して双安定性を有する強誘電性液晶であるカイラルスメクチック液晶5が注入され、シール部材（図示省略）によって封止されている。

【0025】電極基板（配線基板）3a、3bは、ガラス基板6a、6bと、ガラス基板6a、6b上で絶縁膜であるUV（紫外線）硬化樹脂7（電極基板3b側は図示されていない）内に埋め込まれている低抵抗の金属膜からなる金属配線8a、8bと、金属配線8a、8b上に形成されて金属配線8a、8bと電気的に接しているITO膜からなる透明電極9a、9bとでそれぞれ構成されている。透明電極9a、9b上には、配向膜10a、10bがそれぞれ形成されている。

【0026】各電極基板3a、3bの金属配線8a、8b、透明電極9a、9bは、ストライプ状にそれぞれ形成されて単純マトリクス配置され、その交差部で画素が形成されている。

【0027】ガラス基板6a、6bは、液晶基板用としてよく用いられる厚さが1mm程度で、材質はソーダガラス（平板ガラス）のような一般的なものでよく、両面を研磨した平行度のよいものが好ましい。

【0028】UV硬化樹脂7は、UV硬化型樹脂モノマー、オリゴマー及び光開始剤の混合物であり、アクリル系、エポキシ系、エン・チオール系等のいかなる重合方式の物でもよいが、液晶基板作製工程であるITOスパッタ成膜工程や配向膜焼成工程に耐えうる耐熱性、耐薬品性、耐洗浄性を備えていることが必要である。例えば、主成分である反応性オリゴマーに耐熱性のある分子構造を導入したものや、多官能モノマーにより架橋密度を高めたものが好ましい。

【0029】尚、UV硬化樹脂7にはUV（紫外線）光が照射されるが、UV硬化樹脂以外にも、例えば可視光や赤外線光等の照射によって硬化する樹脂を用いることもできる。

【0030】また、金属配線8a、8bの表面には、粒状のスペーサ11が多数配置されており、製造時にUV硬化樹脂7の硬化による表面の収縮を抑制することができる（詳細は後述する）。

【0031】スペーサー11は、ファイバースペーサー、シリカガラス系粒状スペーサー、樹脂系粒状スペーサー、又はこれらのスペーサー表面をメッキ等で金属をコーティングした導電性スペーサー等が用いられる。また、その径の大きさは、UV硬化樹脂7の種類や金属配線8a、8bの厚みにもよるが、0.01~1μm程

度、好ましくは、 $0.05 \sim 0.5 \mu\text{m}$ 程度がよい。

【0032】次に、上述した液晶素子1の電極基板3 a、3 bに適用される本実施の形態に係る配線基板の製造方法を、図2乃至図4を参照して説明する。

【0033】まず、寸法 $300 \times 310 \text{ mm}$ で厚さ 1.1 mm の両面研磨されたガラス基板6上に、スパッタ法により厚さ $2 \mu\text{m}$ のAl（アルミニウム）膜を成膜し、フォトリソエッチング法により幅 $20 \mu\text{m}$ でピッチ $320 \mu\text{m}$ のストライプ形状の金属配線8を形成した（図2（a）参照）。更に、この金属配線8の表面に、例えば平均粒子径 $0.2 \mu\text{m}$ のシリカガラス系のスパーサー（ 0.01 重量部）11を溶剤（例えば、イソプロピルアルコールの 99.99 重量部）に分散させてインクジェットプリンタ装置（図示省略）で塗布した後、 120°C で30分間キュアした（図2（a）参照）。

【0034】そして、このガラス基板6上に、シランカップリング剤（例えば、日本ユニカー（株）社製：A-174（ 1 重量部）とエチルアルコール（ 40 重量部））をスピンコートし、 100°C で20分熱処理を行い密着処理を施した。

【0035】次に、ガラス基板6上の各金属配線8間にディスペンサー等の定量滴下治具（図示省略）を用いてUV硬化樹脂（例えば、ペンタエリスリトールトリアクリレート 50 重量部、ネオペンチルグリコールジアクリレート 50 重量部、1-ヒドロキシシクロヘキシルフェニルケトン 2 重量部からなる硬化収縮率 7% の樹脂）7を所定量滴下した後、寸法 $300 \times 310 \text{ mm}$ の両面研磨されたUV光が透過する表面が平滑な型板12を、気泡を巻き込まないようにゆっくりとUV硬化樹脂7に接触させた（図2（b）、（c）参照）。

【0036】次に、UV硬化樹脂7を挟んだガラス基板6と型板12の一体物に対して、プレス機（図示省略）で上下から例えば1分間かけて所定の圧力（例えば、プレス圧 3 トン ）を加えて全面にわたって密着させ（図3（a）参照）、その後（例えば、約10分後）、プレス機（図示省略）から取り外したガラス基板6と型板12の一体物に対し、型板12側からUV光（例えば、 100 W の高圧水銀ランプ4本で構成された紫外線ランプから照射されるUV光）13を照射してUV硬化樹脂7を硬化させた（図3（b）参照）。

【0037】この際、UV光13の照射によるUV硬化樹脂7の硬化に伴う収縮力Fは、金属配線8の表面に塗布したスパーサー11の変形、及びスパーサー11の金属配線8内へのもぐり込みによって抑制されることにより、UV硬化樹脂7の表面はほぼ平滑面となる。尚、UV硬化樹脂7の硬化に伴う収縮力によるスパーサー11の金属配線8内へのもぐり込み量は、スパーサー11の径の大きさによって調整することができる。

【0038】また、UV硬化樹脂7を加圧するプレス機としては、例えば油圧シリンダーやエアシリンダーに

よるプレス機、ロールプレス機等を用いることができる。

尚、プレス機で加圧する際に、電熱ヒータ又は加熱流体等を通して加熱しておくことにより、UV硬化樹脂7の粘土が低下してガラス基板6上に良好に広がる。

【0039】次に、離型装置（図示省略）を用いて型板12からガラス基板6とUV硬化樹脂7の一体物を剥離し（図3（c）、（d）参照）、UV硬化樹脂7上に、金属配線8と電氣的に接するように金属配線8の配線パターンに合わせて、例えば幅 $300 \mu\text{m}$ 、ピッチ $320 \mu\text{m}$ のITO膜からなる透明電極9をスパッタ形成、パターンニングし、その上に配向膜（図示省略）を形成して、配線基板（図1の液晶素子1の電極基板3 a、3 bに相当している）3を得た（図4参照）。

【0040】そして、この配線基板3を2枚作製して対向配置し、 $1.5 \mu\text{m}$ 程度のセルギャップで貼り合わせてその間にカイラルスメクチック液晶を注入することによって、図1に示した液晶素子1を得た。

【0041】このように、本実施の形態では、製造時のUV光13の照射によるUV硬化樹脂7の硬化に伴う収縮力は、金属配線8の表面に配置したスパーサー11の変形、及びスパーサー11の金属配線8内へのもぐり込みによって抑制されることによって、UV硬化樹脂7の表面は平滑面になる。

【0042】そこで、この配線基板3の表面を顕微鏡観察したところ、図11に示した従来例のような表面の凹凸はほとんど観察されず、UV硬化樹脂7と透明電極9は良好に密着していた。また、スパーサー11は、金属配線8の表面から $0.14 \mu\text{m}$ 程度内部にもぐり込んでいるのが観察され、更に、この電極基板（配線基板）3のバターン長の抵抗値を測定したところ、 300Ω 以下の低抵抗値であった。そして、本実施の形態に係る配線基板（電極基板）3を備えた液晶素子は、上述したようにUV硬化樹脂7の表面が凹凸のない平滑面になるので、配向膜の表面も凹凸のない平滑面となって均一に配向処理されることによって、液晶分子の反転が均一に行われることにより、光学状態のムラやクロストーク等をなくして表示品位の向上を図ることができた。

【0043】また、この液晶素子は、透明電極9の下に金属配線8が併設される構成により、電極の抵抗値が小さくなることによって、強誘電性液晶（本実施の形態では、カイラルスメクチック液晶を用いた）を用いても電圧波形の遅延を低減することができる。

【0044】更に、この液晶素子は、金属配線8の併設により透明電極9を厚くする必要がないので、透明電極9の透過率が下がってこの透明電極9が認識されることはない。

【0045】図5（a）、（b）は、本発明の第2の実施の形態に係る上述した液晶素子1の電極基板3 a、3 bに適用される配線基板の製造工程を模式的に示したものである。

【0046】本実施の形態では、上述した第1の実施の形態と同様な方法でスペーサー11を型板12上に配置して、この型板12上にUV硬化樹脂7を滴下した後（図5（a）参照）、その上方から金属配線8を形成したガラス基板6の金属配線8をUV硬化樹脂7に接触させるようにした（図5（b）参照）。その後、図3乃至図4に示した第1の実施の形態と同様の工程で配線基板を作製した。

【0047】このように、本実施の形態においても第1の実施の形態と同様、UV光13の照射によるUV硬化樹脂7の硬化に伴う収縮力は、金属配線8の表面に配置したスペーサー11の変形、及びスペーサー11の金属配線8内へのもぐり込みによって抑制されることによってUV硬化樹脂7の表面は平滑面となり、UV硬化樹脂7と透明電極9は良好に密着していた。

【0048】よって、本実施の形態に係る配線基板（電極基板）を備えた液晶素子は、上述したようにUV硬化樹脂7の表面が凹凸のない平滑面になるので、配向膜の表面も凹凸のない平滑面となって均一に配向処理されることによって、液晶分子の反転が均一に行われることにより、光学状態のムラやクロストーク等をなくして表示品位の向上を図ることができた。

【0049】図6（a）、（b）、（c）は、本発明の第3の実施の形態に係る上述した液晶素子1の電極基板3a、3bに適用される配線基板の製造工程を模式的に示したものである。

【0050】本実施の形態では、第1の実施の形態と同様、ガラス基板6上に金属配線8を形成してその表面にスペーサー11を塗布した後、ガラス基板6上の金属配線8間に赤（R）、緑（G）、青（B）の各画素で構成される顔料系のカラーフィルター14を、例えばフォトリソエッチング法により約1μmの膜厚で形成した（図6（a）参照）。その後、図3乃至図4に示した第1の実施の形態と同様の工程でカラーフィルター14上の各金属配線8間にUV硬化樹脂7を充填して硬化させ（図6（b）参照）、金属配線8の配線パターンに合わせて、例えば幅300μm、ピッチ320μmのITO膜からなる透明電極9をスパッタ形成、パターンニングし、その上に配向膜（図示省略）を形成して、配線基板（図1の液晶素子1の電極基板3a、3bに相当している）3cを得た（図6（c）参照）。このように、本実施の形態によれば、カラーフィルター機能を有する配線基板3cにおいても第1の実施の形態と同様、UV光13の照射によるUV硬化樹脂7の硬化に伴う収縮力は、金属配線8の表面に配置したスペーサー11の変形、及びスペーサー11の金属配線8内へのもぐり込みによって抑制されることにより、UV硬化樹脂7の表面はほぼ平滑面となり、UV硬化樹脂7と透明電極9は良好に密着していた。

【0051】よって、本実施の形態に係るカラーフィル

ター機能を有する配線基板（電極基板）3cを備えた液晶素子は、上述したようにUV硬化樹脂7の表面が凹凸のない平滑面になるので、配向膜の表面も凹凸のない平滑面となって均一に配向処理されることによって、液晶分子の反転が均一に行われることにより、光学状態のムラやクロストーク等をなくして表示品位の向上を図ることができた。

【0052】尚、カラーフィルター14は、フォトリソエッチング法以外にも、例えば印刷法、昇華転写法、インクジェット法によっても形成することができる。

【0053】図7（a）、（b）、（c）は、本発明の第4の実施の形態に係る上述した液晶素子1の電極基板3a、3bに適用される配線基板の製造工程を模式的に示したものである。

【0054】本実施の形態では、まず、第1の実施の形態で用いたガラス基板6上に親水性アクリル系のインク受容層（カラーフィルター層）15を、例えばスピンコートにより0.8μmの膜厚に形成し、その後、カラーフィルター用インクジェットプリンタ（図示省略）により水性のカラーフィルター用染料インキを、例えば幅300μm、ピッチ320μmで打ち込んでインク受容層15に染み込ませ、更に、200℃で30分加熱して硬化処理してカラーフィルター16を形成した（図6（a）参照）。

【0055】そして、このカラーフィルター16上に第1の実施の形態と同様、スパッタ法により厚さ2μmのAl（アルミニウム）膜を成膜して、フォトリソエッチング法により幅20μm、ピッチ320μmのストライプ形状の金属配線8を形成し、その表面にスペーサー11を塗布した（図10（a）参照）。その後、図2（b）乃至図3に示した第1の実施の形態と同様の工程でカラーフィルター16上の各金属配線8間にUV硬化樹脂7を充填して硬化させ（図7（b）参照）、金属配線8の配線パターンに合わせて、例えば幅300μm、ピッチ320μmのITO膜からなる透明電極9をスパッタ形成、パターンニングし、その上に配向膜（図示省略）を形成して、配線基板（図1の液晶素子1の電極基板3a、3bに相当している）3dを得た（図7（c）参照）。

【0056】このように、本実施の形態によれば、カラーフィルター16上に金属配線8を有する配線基板3dにおいても第1の実施の形態と同様、UV光13の照射によるUV硬化樹脂7の硬化に伴う収縮力は、金属配線8の表面に配置したスペーサー11の変形、及びスペーサー11の金属配線8内へのもぐり込みによって抑制されることによってUV硬化樹脂7の表面は平滑面となり、UV硬化樹脂7と透明電極9は良好に密着していた。

【0057】従って、本実施の形態に係るカラーフィルター機能を有する配線基板（電極基板）3dを備えた液

晶素子は、上述したようにUV硬化樹脂7の表面が凹凸のない平滑面になるので、配向膜の表面も凹凸のない平滑面となって均一に配向処理されることによって、液晶分子の反転が均一に行われることにより、光学状態のムラやクロストーク等をなくして表示品位の向上を図ることができた。

【0058】図8(a)、(b)、(c)は、本発明の第5の実施の形態に係る上述した液晶素子1の電極基板3a、3bに適用される配線基板の製造工程を模式的に示したものである。

【0059】本実施の形態では、上述した第4の実施の形態と同様な方法で第1の実施の形態で用いたガラス基板6上のインク受容層(カラーフィル層)15にカラーフィルター16を形成し、更に、その表面に保護層(例えば、ポリアミド系の透明コーティング剤)17を、約0.5μmの膜厚でスピコート及びベークにより形成した。その後、この保護層17上に第1の実施の形態と同様、スパッタ法により厚さ2μmのAl(アルミニウム)膜を成膜して、フォトリソエッチング法により幅20μm、ピッチ320μmのストライプ形状の金属配線8を形成し、その表面にスペーサー11を塗布した(図8(a)参照)。

【0060】その後、図2(b)乃至図3に示した第1の実施の形態と同様の工程で保護層17上の各金属配線8間にUV硬化樹脂7を充填して硬化させ(図8(b)参照)、金属配線8の配線パターンに合わせて、例えば幅300μm、ピッチ320μmのITO膜からなる透明電極9をスパッタ形成、パターンニングし、その上に配向膜(図示省略)を形成して、配線基板(図1の液晶素子1の電極基板3a、3bに相当している)3eを得た(図8(c)参照)。

【0061】このように、本実施の形態によれば、カラーフィルター16の保護層17上に金属配線8を有する配線基板3eにおいても第1の実施の形態と同様、UV光13の照射によるUV硬化樹脂7の硬化に伴う収縮力は、金属配線8の表面に配置したスペーサー11の変形、及びスペーサー11の金属配線8内へのもぐり込みによって抑制されることによってUV硬化樹脂7の表面はほぼ平滑面となり、UV硬化樹脂7と透明電極9は良好に密着していた。

【0062】従って、本実施の形態に係るカラーフィルター機能を有する配線基板(電極基板)3eを備えた液晶素子は、上述したようにUV硬化樹脂7の表面が凹凸のない平滑面になるので、配向膜の表面も凹凸のない平滑面となって均一に配向処理されることによって、液晶分子の反転が均一に行われることにより、光学状態のムラやクロストーク等をなくして表示品位の向上を図ることができた。

【0063】また、カラーフィルター16上に形成した保護層17により、フォトリソエッチング法により金属

配線8を形成した際に、酸等のエッチング液によるカラーフィルター16の脱色等を防止することができる。

【0064】

【発明の効果】以上説明したように、本発明によれば、金属配線と透明電極の界面に配置したスペーサーにより、金属配線の間に充填される樹脂の硬化による収縮を抑制して樹脂表面が平滑で、樹脂と透明電極が良好に密着した配線基板を提供することができる。

【0065】また、本発明に係る配線基板の製造方法によれば、金属配線と型板との間にスペーサーを配置して、金属配線の間に樹脂を加圧充填して硬化することにより、スペーサの変形、及びスペーサの金属配線内へのもぐり込みによって、樹脂の硬化による収縮が抑制されて樹脂表面が凹凸のない平滑面になり、樹脂と透明電極を良好に密着させることができる。

【0066】また、本発明に係る配線基板を備えた液晶素子によれば、スペーサの変形、及びスペーサの金属配線内へのもぐり込みによって樹脂表面が凹凸のない平滑面になるので、配向膜の表面も凹凸のない平滑面となって均一に配向処理されることによって液晶分子の反転が均一に行われることにより、光学状態のムラやクロストーク等をなくして表示品位の向上を図ることができる。

【図面の簡単な説明】

【図1】本発明の第1の実施の形態に係る配線基板を備えた液晶素子を示す概略断面図。

【図2】第1の実施の形態に係る配線基板の製造方法を説明するための図で、(a)は金属配線上にスペーサーを配置した状態を示す図、(b)は金属配線の間にUV硬化樹脂を滴下した状態を示す図、(c)は型板でUV硬化樹脂を挟む状態を示した図。

【図3】本実施の形態に係る配線基板の製造方法を説明するための図で、(a)はプレス機により型板でUV硬化樹脂を加圧した状態を示す図、(b)はUV硬化樹脂にUV光を照射している状態を示す図、(c)、(d)は型板をUV硬化樹脂から離れた状態を示す図。

【図4】UV硬化樹脂上に透明電極を形成して得られた第1の実施の形態に係る配線基板を示す図。

【図5】第2の実施の形態に係る配線基板の製造方法を説明するための図で、(a)は型板上のスペーサー間にUV硬化樹脂を滴下した状態を示す図、(b)は金属配線を形成したガラス基板でUV硬化樹脂を挟む状態を示した図。

【図6】第3の実施の形態に係る配線基板の製造方法を説明するための図で、(a)は表面にスペーサーを設けた金属配線の間にカラーフィルターを形成した状態を示す図、(b)はカラーフィルター上にUV硬化樹脂を充填して硬化した状態を示す図、(c)はUV硬化樹脂上に透明電極を形成して得られた第3の実施の形態に係る配線基板を示す図。

【図7】第4の実施の形態に係る配線基板の製造方法を

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説明するための図で、(a)はカラーフィルター上に表面にスペーサーを設けた金属配線を形成した状態を示す図、(b)はカラーフィルター上にUV硬化樹脂を充填して硬化した状態を示す図、(c)はUV硬化樹脂上に透明電極を形成して得られた第4の実施の形態に係る配線基板を示す図。

【図8】第5の実施の形態に係る配線基板の製造方法を説明するための図で、(a)はカラーフィルター上に保護層を介して表面にスペーサーを設けた金属配線を形成した状態を示す図、(b)は保護層上にUV硬化樹脂を充填して硬化した状態を示す図、(c)はUV硬化樹脂上に透明電極を形成して得られた第5の実施の形態に係る配線基板を示す図。

【図9】従来例に係る配線基板の製造方法を説明するための図で、(a)はガラス基板上に金属配線を形成した状態を示す図、(b)は金属配線の上にUV硬化樹脂を滴下した状態を示す図、(c)は型板でUV硬化樹脂を挟む状態を示した図。

【図10】従来例に係る配線基板の製造方法を説明するための図で、(a)はプレス機により型板でUV硬化樹脂*

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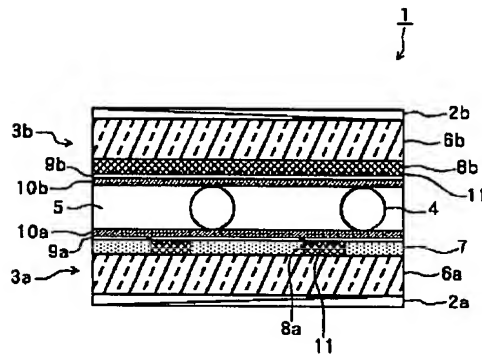
*脂を加圧した状態を示す図、(b)はUV硬化樹脂にUV光を照射している状態を示す図、(c)、(d)は型板をUV硬化樹脂から離した状態を示す図。

【図11】UV硬化樹脂上に透明電極を形成して得られた従来例に係る配線基板を示す図。

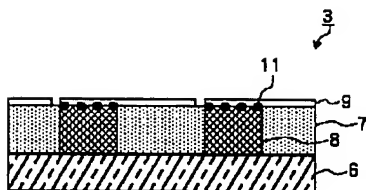
【符号の説明】

- 1 液晶素子
- 3 a, 3 b 電極基板(配線基板)
- 5 カイラルスメックチック液晶(液晶)
- 6, 6 a, 6 b ガラス基板(基板)
- 7 UV硬化樹脂(樹脂)
- 8, 8 a, 8 b 金属配線
- 9, 9 a, 9 b 透明電極
- 10 a, 10 b 配向膜
- 11 スペーサー
- 12 型板
- 13 UV光(光)
- 14, 16 カラーフィルター
- 15 インク受容層
- 17 保護層

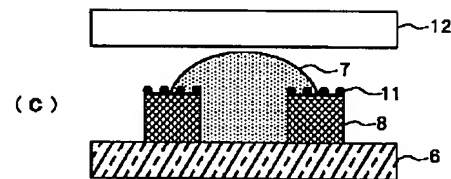
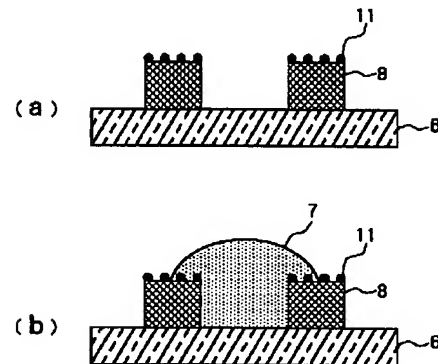
【図1】



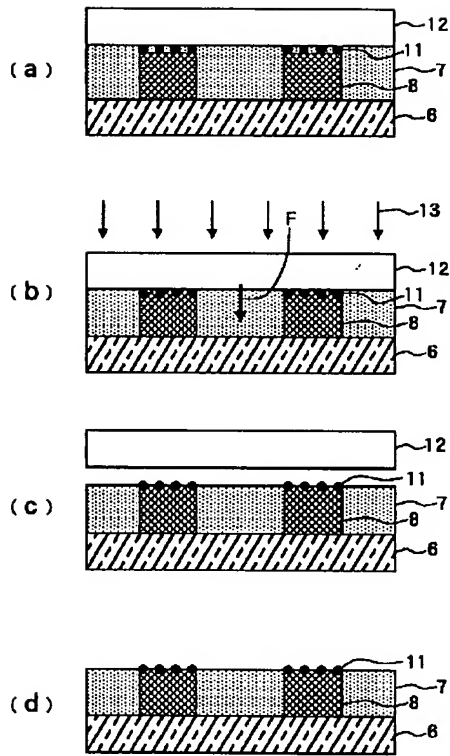
【図4】



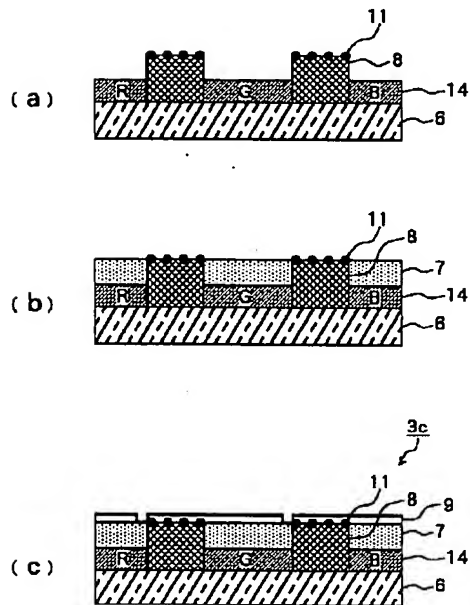
【図2】



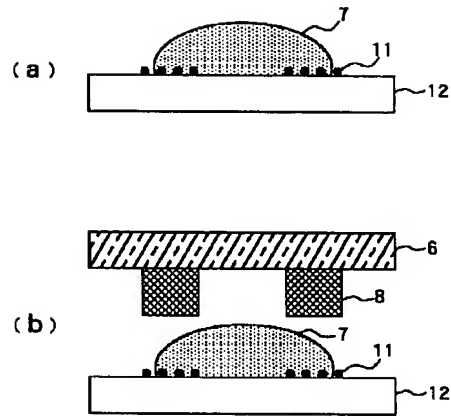
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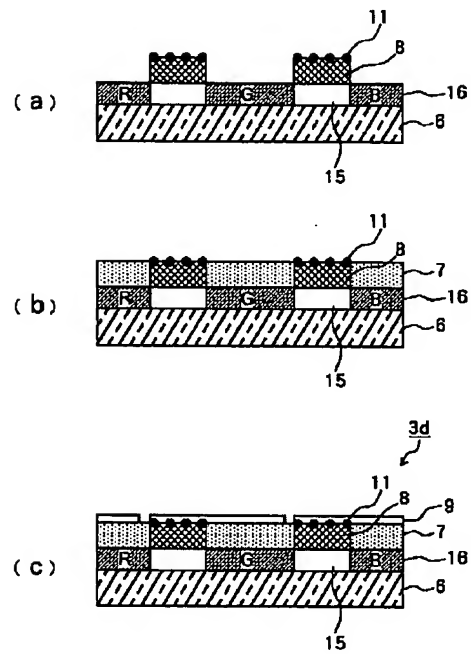
【図6】



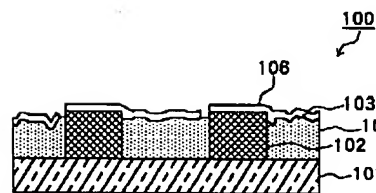
【図5】



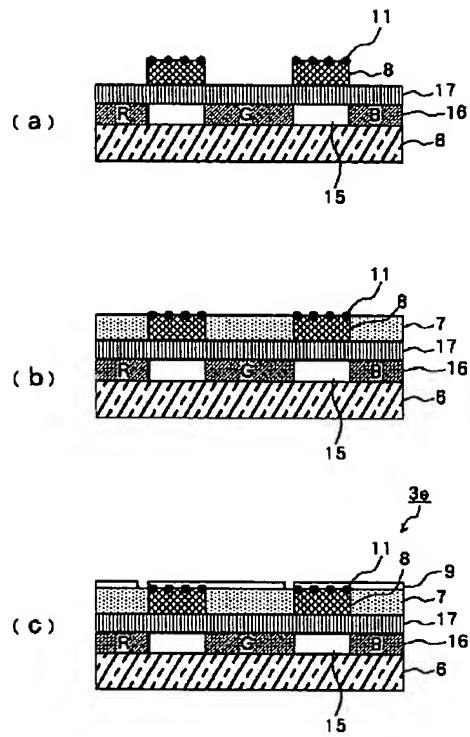
【図7】



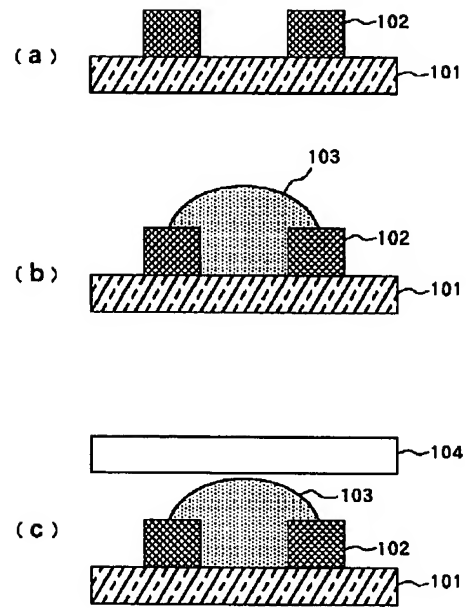
【図11】



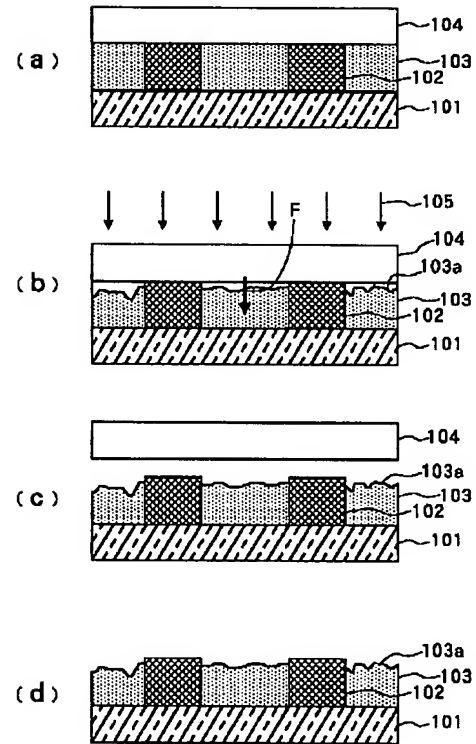
【図8】



【図9】



【図10】



フロントページの続き

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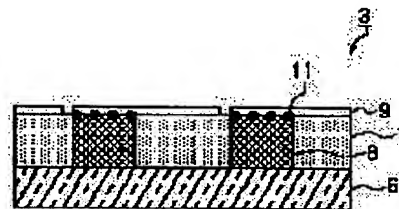
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(54) WIRING BOARD, ITS PRODUCTION AND LIQUID CRYSTAL ELEMENT HAVING THIS WIRING BOARD

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain a wiring board with which the curing of the surface of the resin packed between metallic wirings to a smooth surface is possible by arranging spacers in at least part of the boundary surface of the metallic wirings and transparent electrodes.

SOLUTION: An Al film is formed by a sputtering method on a glass substrate 6 to form the metallic wirings 8. Further, the spacers 11 of a silica glass system are dispersed into a solvent and the soln. prepd. in such a manner is applied on the surface of the metallic wirings 8 and is then cured. The UV curing resin 7 is dropped in a prescribed amt. between the respective metallic wirings 8 on this glass substrate 6 and thereafter, a mold plate having the smooth surface through which UV light passes is brought into contact with the UV curing resin 7. Next, a prescribed pressure is applied on the integral assembly of the glass substrate 6 and the mold plate holding the UV curing resin 7 to bring both into tight contact with each other. Next, the integral assembly of the glass substrate 6 and the UV curing resin 7 is peeled from the mold plate and transparent electrodes 9 are formed on the UV curing resin 7 in compliance with the wiring patterns of the metallic wirings 8. An alignment layer is formed thereon, by which the wiring board 3 is obt'd.



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1. This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.*** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the liquid crystal device equipped with a wiring substrate especially the wiring substrate in which the transparent electrode was formed on metal wiring, its manufacture approach, and this wiring substrate.

[0002]

[Description of the Prior Art] Generally in liquid crystal devices, such as TN (Twisted Nematic) and a STN (Super Twisted Nematic) mold, the ITO (Indium TinOxide) film is conventionally used for the transparent electrode formed on a glass substrate.

[0003] Since the ITO film which constitutes the transparent electrode mentioned above has high resistance, delay of the voltage waveform impressed with enlargement of a screen product and highly-minute-izing like recently has been a problem. Especially, in the liquid crystal device using a ferroelectric liquid crystal, since the cell gap was as narrower as 1-3 micrometers, delay of a voltage waveform was remarkable. Moreover, in order to make resistance low, forming a transparent electrode thickly was also considered, but when thickness was thickened, there were troubles, like that time amount and cost start membrane formation and transparency worsens.

[0004] In order to solve such a trouble, the electrode substrate of a configuration of annexing to the thin transparent electrode of thickness and forming metal wiring of low resistance value is proposed (for example, JP 2-63019A). The electrode substrate currently indicated by this official report embeds metal wiring with a transparent insulating material, and forms transparent electrodes, such as ITO film, on metal wiring which exposed the metal pattern to the front face.

[0005] When producing the electrode substrate of a configuration as mentioned above, the electrode substrate of the configuration using resin transparent as an insulating material which fills and carries out flattening of between metal wiring is proposed (for example, JP 6-347810A). [0006] When such metal wiring of low resistivity was formed in the glass substrate of the substrate which forms a transparent electrode and an electrode substrate (wiring substrate) was produced, it was carried out by the manufacture approach as shown in the former, for example, drawing 9, thru/or drawing 11.

[0007] First, the metal wiring 102 which consists of about 1-micrometer thickness is formed on a glass substrate 101 (refer to drawing 9 (a)). FOTORISO after the metal wiring 102 forms a metal membrane layer on a glass substrate 101 by a spatter etc. --- pattern NINGU can be carried out by law and it can form.

[0008] Next, it is made to contact so that specified quantity dropping of the UV (ultraviolet rays) hardening resin 103 may be carried out with a quantum liquefaction fixture (illustration abbreviation) (refer to drawing 9 (b)) and UV hardening resin 103 may be inserted with the smooth template 104 on the glass substrate 101 which performed silane coupling processing (refer to drawing 9 (c)).

[0009] Next, with a glass substrate 101 and a template 104, an object is put in in a press machine (illustration abbreviation), is really which sandwiched UV hardening resin 103 pressurized, and a glass substrate 101 and a template 104 are stuck (refer to drawing 10 (a)). In order for transparent electrodes, such as ITO film, and the metal wiring 102 to contact at a next

process and to maintain conductivity at this time, it is strong and, moreover, a glass substrate 101 and a template 104 are stuck to homogeneity all over a substrate so that it may become extent in which UV hardening resin 103 is removed from on the front face of the metal wiring 102, or resin remains very thinly.

[0010] Next, in order to stiffen this UV hardening resin 103, the one object of a glass substrate 101 and a template 104 is taken out from the inside of a press machine (illustration abbreviation), the UV (ultraviolet rays) light 105 is irradiated from a template 104 side, and UV hardening resin 103 is stiffened (refer to drawing 10 (b)).

[0011] Next, the one object of a glass substrate 101 and UV hardening resin 103 was exploited from the template 104 with the mold release fixture (illustration abbreviation) (refer to drawing 10 (c) and (d)), and membrane formation and the electrode substrate (wiring substrate) 100 which carried out patterning and embedded the metal wiring 102 UV hardening resin 103 had been obtained for the transparent electrode 106 which consists of ITO film on UV hardening resin 103 as touches the metal wiring 102 electrically (refer to drawing 11).

[0012]

[Problem(s) to be Solved by the Invention] By the way, in the electrode substrate (wiring substrate) 100 produced by the conventional manufacture approach mentioned above, as shown in drawing 10 (b), when the UV light 105 was irradiated by UV hardening resin 103, contraction arose on the front face according to the shrinkage force F by hardening of UV hardening resin 103, and there was a trouble that the front face of UV hardening resin 103 was set to concave convex [not a smooth side but] 103a. Hereafter, it explains that the front face of UV hardening resin 103 is set to concave convex 103a.

[0013] Generally UV hardening resin 103 has several% of hardening contraction alpha, for example, is 2 - 5% by epoxy system resin 6 to 10% in acrylic resin. And if thickness of the metal wiring 102 formed on a glass substrate 101 is set to h, the shrinkage force which is equivalent to the UV hardening resin 103 with which it fills up between the metal wiring 102 per unit volume and at alpha(hardening contraction) xh (thickness), i.e., the force which it is going to shrink by the thickness of alpha(hardening contraction) xh (thickness), will work to the interface of a template 104 and UV hardening resin 103.

[0014] Under the present circumstances, it works as force which is going to tear off UV hardening resin 103 not from the glass substrate 101 with which silane coupling processing is performed but from the template 104 with which silane coupling processing is not performed, consequently UV hardening resin 103 releases from mold the shrinkage force mentioned above since the metal wiring 102 functioned as a stanchion between a template 104 and UV hardening resin 103 from a template 104 in order to raise the adhesion of UV hardening resin 103.

[0015] And since this mold release takes place rapidly, in case it releases from mold, concave convex 103a by contraction will be formed in the front face of UV hardening resin 103.

[0016] Thus, when the front face of UV hardening resin 103 is set to concave convex 103a, in the transparent electrode 106 which consists of ITO film formed by the front face, a front face turns into a concave convex instead of a smooth side similarly. For this reason, the surface smoothness of the contact surface of UV hardening resin 103 and a transparent electrode 106 worsens, and the adhesion of UV hardening resin 103 and a transparent electrode 106 worsens. [0017] Furthermore, in the liquid crystal device which pours in liquid crystal between this wiring substrate (wiring substrate) 100 of a pair, and is obtained, the front face of the orientation film (illustration abbreviation) formed on a transparent electrode 106 turns into a concave convex similarly. For this reason, orientation processing changed into the condition of it having not been uniform and having been confused, and there was a trouble of the nonuniformity and the cross talk of an optical condition having occurred and causing deterioration of display grace.

[0018] Then, this invention aims at offering the liquid crystal device equipped with the wiring substrate which it can harden by making into a smooth field the resin front face with which it is filled up between metal wiring, its manufacture approach, and this wiring substrate.

[0019]

[Means for Solving the Problem] In the wiring substrate which has the transparent electrode formed in the substrate front face between metal wiring by which the circuit pattern was carried

out, and said metal wiring at said this metal wiring, resin [which was filled up with the almost same thickness], and resin top as touched said metal wiring electrically in order to solve the above problems, it is characterized by to have arranged the spacer to a part of interface [at least] of said metal wiring and said transparent electrode.

[0020] Moreover, the 1st process which forms metal wiring on a substrate and the 2nd process which is filled up with resin between said metal wiring, and pressurizes said resin through a template, in the manufacture approach of a wiring substrate of having the 3rd process which said resin is irradiated [process] and makes it hardening light, and the 4th process which forms said transparent electrode as releases said template from mold and touches said metal wiring electrically on said resin it is characterized by arranging a spacer between said metal wiring and said templates, and carrying out pressurization restoration of said resin between said metal wiring and said templates at said 2nd process.

[0021] In the liquid crystal device which comes to pinch liquid crystal between the electrode substrates of the pair arranged so that it may counter mutually moreover, said one [at least] electrode substrate A substrate, metal wiring by which the circuit pattern was carried out to said substrate front face, and the resin filled up with this metal wiring and the almost same thickness between said metal wiring, the transparent electrode formed on said resin as touched said metal wiring electrically — since — it is characterized by having arranged the spacer to a part of interface [at least] of said metal wiring and transparent electrode.

[0022] Moreover, said spacer consists of a particle of textile glass yarn or a resin system, and it is characterized by the particle size being 0.01–1 micrometer.

[0023]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained based on a drawing.

[0024] Drawing 1 is the outline sectional view showing the liquid crystal device equipped with the wiring substrate concerning the gestalt of operation of the 1st of this invention. This liquid crystal device 1 is equipped with the electrode substrates 3a and 3b which are wiring substrates of the pair countered and arranged between polarizing plate 2a and 2b. The electrode substrates 3a and 3b. The path is stuck about the predetermined cel gap (for example, 1.5 micrometers) by the uniform granular spacer 4, the chiral smectic liquid crystal 5 which is a ferroelectric liquid crystal which has a bistability to electric field in the meantime is poured in, and the closure is carried out by the seal member (illustration abbreviation).

[0025] The metal wiring 8a and 8b with which the electrode substrates (wiring substrate) 3a and 3b consist of a metal membrane of low resistance currently embedded in glass substrates 6a and 6b and the UV (ultraviolet rays) hardening resin 7 (not shown [the electrode substrate 3b side]) which is an insulator layer on glass substrate 6a and 6b, it consists of transparent electrodes 9a and 9b which consist of ITO film which was formed on metal wiring 8a and 8b, and is electrically in contact with the metal wiring 8a and 8b, respectively. On transparent electrode 9a and 9b, the orientation film 10a and 10b is formed, respectively.

[0026] The metal wiring 8a and 8b of each electrode substrates 3a and 3b and transparent electrodes 9a and 9b are formed in the shape of a stripe, respectively, passive-matrix arrangement is carried out, and the pixel is formed by the intersection.

[0027] As for glass substrates 6a and 6b, what has the thickness good [the parallelism which the quality of the material is easy to be a general thing like soda glass (blue plate glass), and ground both sides by about 1mm] well used as an object for liquid crystal substrates is desirable.

[0028] UV hardening resin 7 needs to have the thermal resistance which can bear the ITO spatter membrane formation process and orientation film baking process which are the mixture of UV hardening mold resin monomer, oligomer, and a photoinitiator, and are a liquid crystal substrate making process although the object of what kind of polymerization methods, such as acrylic, an epoxy system, and an en thiol system, is sufficient, chemical resistance, and washability. For example, what introduced the molecular structure which has thermal resistance in the reactant oligomer monomer is a principal component, and the thing which raised crosslinking density by polyfunctional monomer are desirable.

[0029] In addition, although UV (ultraviolet rays) light is irradiated by UV hardening resin 7, the resin hardened by the exposure of the light, infrared light, etc. besides UV hardening resin can also be used.

[0030] Moreover, in the front face of the metal wiring 8a and 8b, many granular spacers 11 are arranged and contraction of the front face by hardening of UV hardening resin 7 can be controlled at the time of manufacture (it mentions later for details).

[0031] As for a spacer 11, the conductive spacer which coated the metal with plating etc. is used in a fiber spacer, a silica glass system granular spacer, resin system granular spacers, or these spacer front faces. Moreover, although the magnitude of the path is based also on the thickness of the class metallurgy group wiring 8a and 8b of UV hardening resin 7, about 0.01–1 micrometer its about 0.05–0.5 micrometers are good preferably.

[0032] Next, the manufacture approach of the wiring substrate concerning the gestalt of this operation applied to the electrode substrates 3a and 3b of a liquid crystal device 1 mentioned above is explained with reference to drawing 2 thru/or drawing 4.

[0033] First, aluminum (aluminum) film with a thickness of 2 micrometers was formed by the spatter with the dimension of 300x310mm on the glass substrate 6 with a thickness of 1.1mm by which double-sided polish was carried out, and the metal wiring 8 of a pitch 320micrometer stripe configuration was formed by width of face of 20 micrometers by the photolitho-etching method (refer to drawing 2 (a)). Furthermore, after making the solvent (for example, 99.99 weight sections of isopropyl alcohol) distribute the spacer (0.01 weight sections) 11 of a silica glass system with a mean particle diameter of 0.2 micrometers on the front face of this metal wiring 8 and applying to it with ink jet printer equipment (illustration abbreviation), the cure was carried out for 30 minutes at 120 degrees C (refer to drawing 2 (a)).

[0034] And on this glass substrate 6, the spin coat of the silane coupling agent (for example, Nippon Unicar make: A-174 (1 weight section) and ethyl alcohol (40 weight sections)) was carried out, heat treatment was performed at 100 degrees C for 20 minutes, and adhesion processing was performed.

[0035] Quantum dropping fixtures (illustration abbreviation), such as a dispenser, are used between each metal wiring 8 on a glass substrate 6. Next, UV hardening resin for example, the pentaerythritol thoria chestnut rate 50 weight section and the neopentyl-glycol-diacylate 50 weight section — After carrying out specified quantity dropping of the resin 7 of % of hardening contraction which consists of the 1-hydroxy cyclohexyl phenyl ketone 2 weight section, The template 12 with the smooth front face which UV light with a dimension of 300x310mm by which double-sided polish was carried out penetrates was slowly contacted to UV hardening resin 7 so that air bubbles might not be involved in (refer to drawing 2 (b) and (c)).

[0036] Next, the one object of a glass substrate 6 and a template 12 which sandwiched UV hardening resin 7 is received, it applies, for example for 1 minute from the upper and lower sides with a press machine (illustration abbreviation). A predetermined pressure Apply (3t of for example, press **), and it is made to stick over the whole surface (refer to drawing 3 (a)). As opposed to the one object of a glass substrate 6 and a template 12 removed from the press machine (illustration abbreviation) after that (for example, after about 10 minutes) The UV light (for example, UV light irradiated from the ultraviolet ray lamp which consisted of four high-pressure mercury lamps of 100w) 13 was irradiated from the template 12 side, and UV hardening resin 7 was stiffened (refer to drawing 3 (b)).

[0037] Under the present circumstances, when the shrinkage force F accompanying hardening of the UV hardening resin 7 by the exposure of the UV light 13 is controlled by the going underwater lump into deformation of the spacer 11 applied to the front face of the metal wiring 8, and the metal wiring 8 of a spacer 11, the front face of UV hardening resin 7 turns into a smooth side mostly. In addition, it can go underwater and the magnitude through which it passes in the metal wiring 8 of the spacer 11 by the shrinkage force accompanying hardening of UV hardening resin 7, and which is the path of a spacer 11 can adjust the amount of lumps.

[0038] Moreover, as a press machine which pressurizes UV hardening resin 7, the press machine by the oil hydraulic cylinder or the pneumatic cylinder, a roll press machine, etc. can be used, for example. In addition, in case it pressurizes with a press machine, by letting pass and heating in

the electrical heater or the heating fluid, the clay of UV hardening resin 7 falls and it spreads good on a glass substrate 6.

[0039] Next, mold release equipment (illustration abbreviation) — using — the one object of a template 12 to the glass substrate 6, and UV hardening resin 7 — exfoliating (drawing 3 (c) —) (d) it doubles with the circuit pattern of the metal wiring 8 so that the metal wiring 8 may be electrically touched on reference and UV hardening resin 7. For example, it spatter-formed, pattern NINGU of the transparent electrode 9 which consists of width-of-face [of 300 micrometers] and pitch 320micrometer ITO film was carried out, the orientation film (illustration abbreviation) was formed on it, and the wiring substrate (it is equivalent to the electrode substrates 3a and 3b of the liquid crystal device 1 of drawing 1) 3 was obtained (refer to drawing 4).

[0040] And the liquid crystal device 1 shown in drawing 1 was obtained by producing these two wiring substrates 3, carrying out opposite arrangement, sticking about the cel gap of about 1.5 micrometers, and pouring in chiral smectic liquid crystal between them.

[0041] Thus, with the gestalt of this operation, when the shrinkage force accompanying hardening of the UV hardening resin 7 by the exposure of the UV light 13 at the time of manufacture is controlled by the going underwater lump into deformation of the spacer 11 arranged on the front face of the metal wiring 8, and the metal wiring 8 of a spacer 11, the front face of UV hardening resin 7 turns into a smooth side.

[0042] Then, when microscope observation of the front face of this wiring substrate 3 was carried out, most irregularity of a front face like the conventional example shown in drawing 11 was not observed, but UV hardening resin 7 and a transparent electrode 9 were stuck good. Moreover, the spacer 11 was 300ohms or less in low resistance value, when going inside under about 0.14 micrometers from the front face of the metal wiring 8 was observed and it measured the resistance of the pattern length of this electrode substrate (wiring substrate) 3 further. And the liquid crystal device equipped with the wiring substrate (electrode substrate) 3 concerning the gestalt of this operation Since the front face of UV hardening resin 7 turns into a smooth side without irregularity as mentioned above When the front face of the orientation film also turned into a smooth side without irregularity and orientation processing was carried out at homogeneity, by carrying out reversal of a liquid crystal molecule to homogeneity, nonuniformity, a cross talk, etc. of an optical condition were able to be lost and improvement in display grace was able to be aimed at.

[0043] Moreover, by the configuration that the metal wiring 8 is put side by side to the bottom of a transparent electrode 9, when the resistance of an electrode becomes small, even if the ferroelectric liquid crystal (chiral smectic liquid crystal) was used with the gestalt of this operation) is used for this liquid crystal device, it can reduce delay of a voltage waveform.

[0044] Furthermore, since this liquid crystal device does not have to thicken a transparent electrode 9 by juxtaposition of the metal wiring 8, the permeability of a transparent electrode 9 falls and this transparent electrode 9 is not recognized.

[0045] Drawing 5 (a) and (b) show typically the production process of the wiring substrate applied to the electrode substrates 3a and 3b of the liquid crystal device 1 concerning the gestalt of operation of the 2nd of this invention mentioned above.

[0046] After having arranged the spacer 11 on a template 12 by the same approach as the gestalt of the 1st operation mentioned above and dropping UV hardening resin 7 on this template 12 (refer to drawing 5 (a)), it was made to contact the metal wiring 8 of the glass substrate 6 which formed the metal wiring 8 from that upper part to UV hardening resin 7 with the gestalt of this operation (refer to drawing 5 (b)). Then, the wiring substrate was produced at the same process as the gestalt of the 1st operation shown in drawing 3 thru/or drawing 4.

[0047] Thus, when the shrinkage force accompanying hardening of the UV hardening resin 7 by the exposure of the UV light 13 as well as the gestalt of the 1st operation was controlled also in the gestalt of this operation by the going underwater lump into deformation of the spacer 11 arranged on the front face of the metal wiring 8, and the metal wiring 8 of a spacer 11, the front face of UV hardening resin 7 turned into a smooth side, and UV hardening resin 7 and a transparent electrode 9 were stuck good.

[0048] Therefore, the liquid crystal device equipped with the wiring substrate (electrode substrate) concerning the gestalt of this operation Since the front face of UV hardening resin 7 turns into a smooth side without irregularity as mentioned above When the front face of the orientation film also turned into a smooth side without irregularity and orientation processing was carried out at homogeneity, by carrying out reversal of a liquid crystal molecule to homogeneity, nonuniformity, a cross talk, etc. of an optical condition were able to be lost and improvement in display grace was able to be aimed at.

[0049] Drawing 6 (a), (b), and (c) show typically the production process of the wiring substrate applied to the electrode substrates 3a and 3b of the liquid crystal device 1 concerning the gestalt of operation of the 3rd of this invention mentioned above.

[0050] With the gestalt of this operation, after forming the metal wiring 8 on the glass substrate 6 and applying a spacer 11 to the front face like the gestalt of the 1st operation, the color filter 14 of red (R), green (G), and the pigment system that consists of each blue (B) pixel was formed about 1-micrometer thickness for example, by the photolitho-etching method between the metal wiring 8 on a glass substrate 6 (refer to drawing 6 (a)). Then, UV hardening resin 7 is filled up with and stiffened between each metal wiring 8 on a color filter 14 at the same process as the gestalt of the 1st operation shown in drawing 3 thru/or drawing 4 (refer to drawing 6 (b)).

According to the circuit pattern of the metal wiring 8, spatter-form, carry out pattern NINGU of the transparent electrode 9 which consists of width-of-face [of 300 micrometers], and pitch 320micrometer ITO film, and the orientation film (illustration abbreviation) is formed on it. Wiring substrate (it is equivalent to electrode substrates 3a and 3b of liquid crystal device 1 of drawing 1) 3c was obtained (refer to drawing 6 (c)). Also in wiring substrate 3c which has a color filter function according to the gestalt of this operation thus, like the gestalt of the 1st operation The shrinkage force accompanying hardening of the UV hardening resin 7 by the exposure of the UV light 13 When controlled by the going underwater lump into deformation of the spacer 11 arranged on the front face of the metal wiring 8, and the metal wiring 8 of a spacer 11 the front face of UV hardening resin 7 turned into a smooth side mostly, and UV hardening resin 7 and a transparent electrode 9 were stuck good.

[0051] Therefore, the liquid crystal device equipped with wiring substrate (electrode substrate) 3c which has a color filter function concerning the gestalt of this operation Since the front face of UV hardening resin 7 turns into a smooth side without irregularity as mentioned above When the front face of the orientation film also turned into a smooth side without irregularity and orientation processing was carried out at homogeneity, by carrying out reversal of a liquid crystal molecule to homogeneity, nonuniformity, a cross talk, etc. of an optical condition were able to be lost and improvement in display grace was able to be aimed at.

[0052] In addition, a color filter 14 can be formed also by print processes, the sublimation replica method, and the ink jet method besides the photolitho-etching method.

[0053] Drawing 7 (a), (b), and (c) show typically the production process of the wiring substrate applied to the electrode substrates 3a and 3b of the liquid crystal device 1 concerning the gestalt of operation of the 4th of this invention mentioned above.

[0054] With the gestalt of this operation, first the ink absorbing layer (color filter layer) 15 of hydrophilic acrylic on the glass substrate 6 used with the gestalt of the 1st operation it forms in 0.8-micrometer thickness with a spin coat. With the ink jet printer for color filters (illustration abbreviation) after that for example, the water color ink for color filters For example, devote oneself by width-of-face [of 300 micrometers], and pitch 320micrometer, and it was made to sink into an ink absorbing layer 15, and further, at 200 degrees C, it heated for 30 minutes. hardening processing was carried out, and the color filter 16 was formed (refer to drawing 6 (a)). [0055] And on this color filter 16, aluminum (aluminum) film with a thickness of 2 micrometers was formed by the spatter, the metal wiring 8 of width of face of 20 micrometers and a pitch 320micrometer stripe configuration was formed by the photolitho-etching method like the gestalt of the 1st operation, and the spacer 11 was applied to that front face (refer to drawing 10 (a)). Then, UV hardening resin 7 is filled up with and stiffened between each metal wiring 8 on a color filter 16 at the same process as the gestalt of the 1st operation shown in drawing 2 (b) thru/or drawing 3 (refer to drawing 7 (b)). According to the circuit pattern of the metal wiring 8, spatter-

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CLAIMS

[Claim(s)]

[Claim 1] The wiring substrate characterized by what the spacer has been arranged for to a part of interface [at least] of said metal wiring and said transparent electrode in the wiring substrate which has the transparent electrode formed in the substrate front face between metal wiring by which the circuit pattern was carried out, and said metal wiring at said this metal wiring, resin [which was filled up with the almost same thickness], and resin top as touched said metal wiring electrically.

[Claim 2] It is the wiring substrate according to claim 1 the particle size of whose said spacer consists of a particle of textile glass yarn or a resin system, and is 0.01-1 micrometer.

[Claim 3] Said transparent electrode is a wiring substrate according to claim 1 which is the ITO film.

[Claim 4] Said metal wiring is a wiring substrate according to claim 1 formed with the metal or metal alloy of low resistance.

[Claim 5] Said resin is a wiring substrate according to claim 1 which is ultraviolet-rays hardening resin.

[Claim 6] The wiring substrate according to claim 1 which has arranged the color filter between said metal wiring on said substrate.

[Claim 7] The wiring substrate according to claim 1 which has arranged the color filter between said substrates and said metal wiring.

[Claim 8] The wiring substrate according to claim 7 in which the protective layer of said color filter was formed between said color filters and said metal wiring.

[Claim 9] The 1st process which forms metal wiring on a substrate, and the 2nd process which is filled up with resin between said metal wiring, and pressurizes said resin through a template, in the manufacture approach of a wiring substrate of having the 3rd process which said resin is irradiated [process] and makes it hardening light, and the 4th process which forms said transparent electrode as releases said template from mold and touches said metal wiring electrically on said resin The manufacture approach of the wiring substrate characterized by what a spacer is arranged between said metal wiring and said templates, and is done for the pressurization restoration of said resin between said metal wiring and said templates at said 2nd process.

[Claim 10] It is the manufacture approach of a wiring substrate according to claim 9 that said spacer consists of a particle of textile glass yarn or a resin system, and the particle size is 0.01-1 micrometer.

[Claim 11] Said transparent electrode is the manufacture approach of the wiring substrate according to claim 9 which is the ITO film.

[Claim 12] Said metal wiring is the manufacture approach of the wiring substrate according to claim 9 formed with the metal or metal alloy of low resistance.

[Claim 13] Said light is the manufacture approach of the wiring substrate according to claim 9 which is ultraviolet-rays light.

[Claim 14] Said resin is the manufacture approach of the wiring substrate according to claim 9 which is ultraviolet-rays hardening resin.

[Claim 15] The manufacture approach of the wiring substrate according to claim 9 which has arranged the color filter between said metal wiring on said substrate.

[Claim 16] The manufacture approach of the wiring substrate according to claim 9 which has arranged the color filter between said substrates and said transparent electrodes.

[Claim 17] The manufacture approach of the wiring substrate according to claim 16 in which the protective layer of said color filter was formed between said color filters and said metal wiring.

[Claim 18] In the liquid crystal device which comes to pinch liquid crystal between the electrode substrates of the pair arranged so that it may counter mutually said one [at least] electrode substrate A substrate, metal wiring by which the circuit pattern was carried out to said substrate front face, and the resin with which the almost same thickness was filled up with this metal wiring between said metal wiring, the transparent electrode formed on said resin as touched said metal wiring electrically -- since -- the liquid crystal device characterized by what the spacer has been arranged for to a part of interface [at least] of said metal wiring and said transparent electrode.

[Claim 19] It is the liquid crystal device according to claim 18 the particle size of whose said spacer consists of a particle of textile glass yarn or a resin system, and is 0.01-1 micrometer.

[Claim 20] Said substrate is a liquid crystal device according to claim 18 which is a glass substrate.

[Claim 21] Said transparent electrode is a liquid crystal device according to claim 18 which is the ITO film.

[Claim 22] Said metal wiring is a liquid crystal device according to claim 18 formed with the metal or metal alloy of low resistance.

[Claim 23] Said resin is a liquid crystal device according to claim 18 which is ultraviolet-rays hardening resin.

[Claim 24] The liquid crystal device according to claim 18 which has arranged the color filter between said metal wiring on said substrate.

[Claim 25] The liquid crystal device according to claim 18 which has arranged the color filter between said substrates and said metal wiring.

[Claim 26] The liquid crystal device according to claim 25 in which the protective layer of said color filter was formed between said color filters and said metal wiring.

[Claim 27] Said liquid crystal is a liquid crystal device according to claim 18 which is a ferroelectric liquid crystal.

[Claim 28] Said ferroelectric liquid crystal is a liquid crystal device according to claim 27 which is chiral smectic liquid crystal.

[Claim 29] The liquid crystal device according to claim 18 in which the orientation film was formed on said transparent electrode.

[Claim 30] Said transparent electrode of each of said electrode substrate and said metal wiring are a liquid crystal device according to claim 18 by which passive-matrix arrangement is carried out.

[Translation done.]

form, carry out pattern NINGU of the transparent electrode 9 which consists of width-of-face [of 300 micrometers], and pitch 320micrometer ITO film, and the orientation film (illustration abbreviation) is formed on it. 3d (it is equivalent to the electrode substrates 3a and 3b of the liquid crystal device 1 of drawing 1) of wiring substrates was obtained (refer to drawing 7 (c)). [0056] Also in 3d of wiring substrates which have the metal wiring 8 on a color filter 16 according to the gestalt of this operation thus, like the gestalt of the 1st operation The shrinkage force accompanying hardening of the UV hardening resin 7 by the exposure of the UV light 13 When controlled by the going underwater lump into deformation of the spacer 11 arranged on the front face of the metal wiring 8, and the metal wiring 8 of a spacer 11, the front face of UV hardening resin 7 turned into a smooth side, and UV hardening resin 7 and a transparent electrode 9 were stuck good.

[0057] Therefore, the liquid crystal device equipped with 3d (electrode substrate) of wiring substrates which have a color filter function concerning the gestalt of this operation Since the front face of UV hardening resin 7 turns into a smooth side without irregularity as mentioned above When the front face of the orientation film also turned into a smooth side without irregularity and orientation processing was carried out at homogeneity, by carrying out reversal of a liquid crystal molecule to homogeneity, nonuniformity, a cross talk, etc. of an optical condition were able to be lost and improvement in display grace was able to be aimed at. [0058] Drawing 8 (a), (b), and (c) show typically the production process of the wiring substrate applied to the electrode substrates 3a and 3b of the liquid crystal device 1 concerning the gestalt of operation of the 5th of this invention mentioned above.

[0059] With the gestalt of this operation, the color filter 16 was formed in the ink absorbing layer 15 on the glass substrate 6 used with the gestalt of the 1st operation by the same approach as the gestalt of the 4th operation mentioned above (color FIRU layer), and the protective layer (for example, transparency coating agent of a polyamide system) 17 was further formed in the front face with a spin coat and baking at about 0.5-micrometer thickness. Then, on this protective layer 17, aluminum (aluminum) film with a thickness of 2 micrometers was formed by the sputter, the metal wiring 8 of width of face of 20 micrometers and a pitch 320micrometer stripe configuration was formed by the photolitho-etching method like the gestalt of the 1st operation, and the spacer 11 was applied to that front face (refer to drawing 8 (a)).

[0060] Then, UV hardening resin 7 is filled up with and stiffened between each metal wiring 8 on a protective layer 17 at the same process as the gestalt of the 1st operation shown in drawing 2 (b) thru/or drawing 3 (refer to drawing 8 (b)). According to the circuit pattern of the metal wiring 8, spatter-form, carry out pattern NINGU of the transparent electrode 9 which consists of width-of-face [of 300 micrometers], and pitch 320micrometer ITO film, and the orientation film (illustration abbreviation) is formed on it. Wiring substrate (it is equivalent to electrode substrates 3a [3] and 3b of liquid crystal device 1 of drawing 1) 3c was obtained (refer to drawing 8 (c)).

[0061] Also in wiring substrate 3c which has the metal wiring 8 on the protective layer 17 of a color filter 16 according to the gestalt of this operation thus, like the gestalt of the 1st operation The shrinkage force accompanying hardening of the UV hardening resin 7 by the exposure of the UV light 13 When controlled by the going underwater lump into deformation of the spacer 11 arranged on the front face of the metal wiring 8, and the metal wiring 8 of a spacer 11, the front face of UV hardening resin 7 turned into a smooth side mostly, and UV hardening resin 7 and a transparent electrode 9 were stuck good.

[0062] Therefore, the liquid crystal device equipped with wiring substrate (electrode substrate) 3c which has a color filter function concerning the gestalt of this operation Since the front face of UV hardening resin 7 turns into a smooth side without irregularity as mentioned above When the front face of the orientation film also turned into a smooth side without irregularity and orientation processing was carried out at homogeneity, by carrying out reversal of a liquid crystal molecule to homogeneity, nonuniformity, a cross talk, etc. of an optical condition were able to be lost and improvement in display grace was able to be aimed at.

[0063] Moreover, by the protective layer 17 formed on the color filter 16, when the metal wiring 8 is formed by the photolitho-etching method, decolorization of the color filter 16 by etching

reagents, such as an acid, etc. can be prevented.

[0064]

[Effect of the Invention] According to this invention, as explained above, contraction by hardening of the resin with which it fills up between metal wiring is controlled with the spacer arranged to the interface of metal wiring and a transparent electrode, a resin front face is smooth and the wiring substrate which resin and a transparent electrode stuck good can be offered.

[0065] Moreover, according to the manufacture approach of the wiring substrate concerning this invention, by arranging a spacer between metal wiring and a template, carrying out pressurization restoration and hardening resin between metal wiring, it can become the smooth side where contraction by hardening of resin is controlled and a resin front face does not have irregularity, and resin and a transparent electrode can be stuck good by the going underwater lump into deformation of a spacer and metal wiring of a spacer.

[0066] Moreover, since a resin front face turns into a smooth side without irregularity by the going underwater lump into deformation of a spacer and metal wiring of a spacer according to the liquid crystal device equipped with the wiring substrate concerning this invention When the front face of the orientation film also turns into a smooth side without irregularity and orientation processing is carried out at homogeneity, by carrying out reversal of a liquid crystal molecule to homogeneity, nonuniformity, a cross talk, etc. of an optical condition can be lost and improvement in display grace can be aimed at.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The outline sectional view showing the liquid crystal device equipped with the wiring substrate concerning the gestalt of operation of the 1st of this invention.

[Drawing 2] For drawing showing the condition of having arranged the spacer on metal wiring, and (b), in drawing for explaining the manufacture approach of the wiring substrate concerning the gestalt of the 1st operation, (c) is [(a)] drawing showing the condition that UV hardening resin was dropped between metal wiring, and drawing having shown the condition of inserting UV hardening resin with a template.

[Drawing 3] For drawing showing the condition of having pressurized UV hardening resin with the press machine at the template, and (b), in drawing for explaining the manufacture approach of the wiring substrate concerning the gestalt of this operation, drawing showing the condition of irradiating UV light at UV hardening resin, (c), and (d) are [(a)] drawing showing the condition of having separated the template from UV hardening resin.

[Drawing 4] Drawing showing the wiring substrate concerning the gestalt of the 1st operation which formed the transparent electrode on UV hardening resin, and was obtained.

[Drawing 5] For (a), in drawing for explaining the manufacture approach of the wiring substrate concerning the gestalt of the 2nd operation, drawing showing the condition that UV hardening resin was dropped between the spacers on a template, and (b) are drawing having shown the condition of inserting UV hardening resin with the glass substrate in which metal wiring was formed.

[Drawing 6] It is drawing showing the wiring substrate concerning the gestalt of the 3rd operation which drawing showing the condition that (a) formed a color filter between metal wiring which formed the spacer in the front face, drawing showing the condition that (b) filled up with and hardened UV hardening resin on a color filter, and (c) formed a transparent electrode on UV hardening resin with drawing for explaining the manufacture approach of the wiring substrate concerning the gestalt of the 3rd operation, and was obtained.

[Drawing 7] It is drawing showing the wiring substrate concerning the gestalt of the 4th operation which drawing showing the condition that (a) formed metal wiring which formed the spacer on the front face on the color filter, drawing showing the condition that (b) filled up with and hardened UV hardening resin on a color filter, and (c) formed a transparent electrode on UV hardening resin with drawing for explaining the manufacture approach of the wiring substrate concerning the gestalt of the 4th operation, and was obtained.

[Drawing 8] In drawing for explaining the manufacture approach of the wiring substrate concerning the gestalt of the 5th operation Drawing showing the condition that (a) formed metal wiring which formed the spacer on the front face through the protective layer on the color filter, For (b), (c) is drawing showing the condition of having filled up with and hardened UV hardening resin on the protective layer, and drawing showing the wiring substrate concerning the gestalt of the 5th operation which formed the transparent electrode on UV hardening resin, and was obtained.

[Drawing 9] For drawing showing the condition of having formed metal wiring on the glass substrate, and (b), in drawing for explaining the manufacture approach of the wiring substrate

concerning the conventional example, (c) is [(a)] drawing showing the condition that UV hardening resin was dropped between metal wiring, and drawing having shown the condition of inserting UV hardening resin with a template.

[Drawing 10] For drawing showing the condition of having pressurized UV hardening resin with the press machine at the template, and (b), in drawing for explaining the manufacture approach of the wiring substrate concerning the conventional example, drawing showing the condition of irradiating UV light at UV hardening resin, (c), and (d) are [(a)] drawing showing the condition of having separated the template from UV hardening resin.

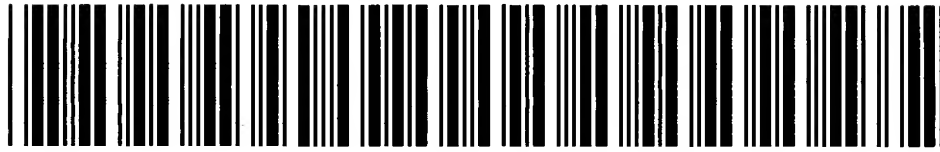
[Drawing 11] Drawing showing the wiring substrate concerning the conventional example which formed the transparent electrode on UV hardening resin, and was acquired.

[Description of Notations]

- 1 Liquid Crystal Device
- 3a, 3b Electrode substrate (wiring substrate)
- 5 Chiral Smectic Liquid Crystal (Liquid Crystal)
- 6, 6a, 6b Glass substrate (substrate)
- 7 UV Hardening Resin (Resin)
- 8, 8a, 8b Metal wiring
- 9, 9a, 9b Transparent electrode
- 10a, 10b Orientation film
- 11 Spacer
- 12 Template
- 13 UV Light (Light)
- 14 16 Color filter
- 15 Ink Absorbing Layer
- 17 Protective Layer

[Translation done.]

IDS REFERENCES



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